

The Force of Friction

Friction is the force that opposes motion. It has the symbol F_f . There are 2 major types of friction:

1. **Static friction** - the force that opposes the start of motion
2. **Kinetic friction** - the force that opposes motion for 2 objects in relative motion (already moving)

The **coefficient of friction** is a constant that tells us the relationship between two surfaces in contact. It has no units because it is a ratio. The symbol is the Greek letter μ . Recall that the Normal force is the force that acts opposite to weight on a flat surface. Using these variables we can calculate the force of friction using:

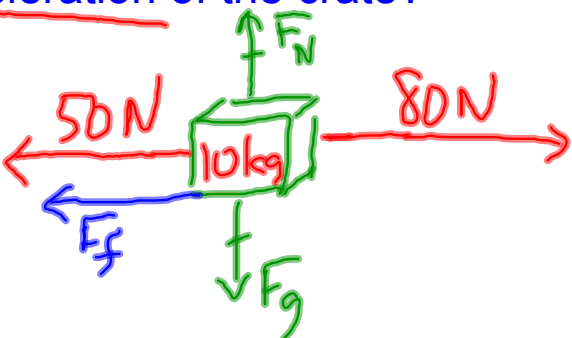
$$F_f = \mu F_N$$

Where:

F_f	is the force of friction
μ	is the coefficient of friction
F_N	is the normal force (or F_g)

Sample problem #1

Two people are pushing horizontally on a 10.0kg crate. One pushes from the right with a 50N force. The other pushes from the left with an 80N force. If the coefficient of friction is 0.30, what is the acceleration of the crate?



$$F_{\text{net}} = 80 - 50$$

$$= 30\text{N}$$

$$F_g = mg$$

$$= 10 \times 9.81$$

$$F_g = 98.1\text{N} = F_N$$

$$F_f = \mu F_N$$

$$= 0.30 \times 98.1\text{N}$$

$$= 29.4\text{N}$$

$$m = 10\text{kg}$$

$$g = -9.81\text{m/s}^2$$

$$\mu_k = 0.30$$

$$F_1 = -50\text{N}$$

$$F_2 = +80\text{N}$$

$$F_{\text{net}} = 30\text{N} - 29.4\text{N}$$

$$= 0.60\text{N}$$

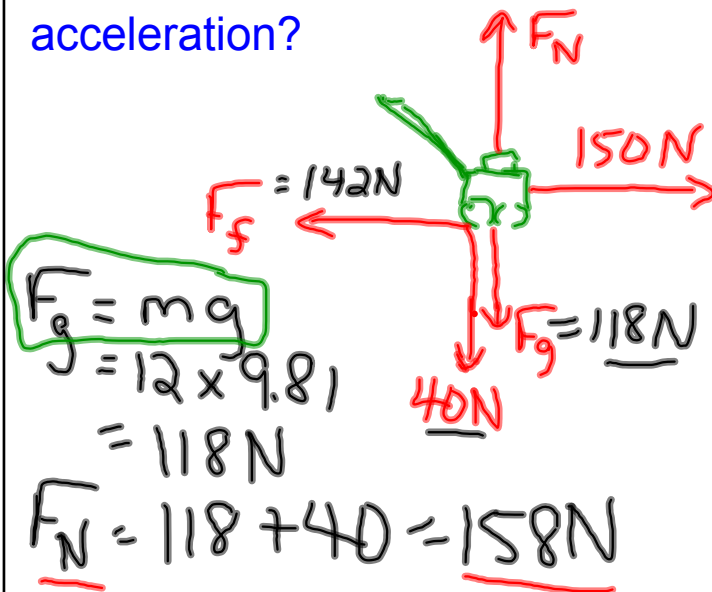
$$F_{\text{net}} = ma$$

$$\frac{0.60\text{N}}{10\text{kg}} = 10\text{kg } a$$

$$0.060\text{m/s}^2 = a$$

Sample problem #2

A 12kg lawn mower is pushed by a force 150N horizontally and 40N down. If the coefficient of kinetic friction is 0.90, what force of friction acts on the lawn mower? What is the mower's acceleration?



$m = 12 \text{ kg}$
 $F_1 = 150 \text{ horizontal}$
 $F_2 = 40 \text{ down}$
 $\mu_k = 0.90$

$F_f = \mu_k F_N$
 $= 0.90 \times 158 \text{ N}$
 $= 142 \text{ N}$

$F_{\text{net}} = 150 - 142$
 $= 8 \text{ N}$

$F_{\text{net}} = ma$
 $8 \text{ N} = 12(a)$
 $a = 0.7 \text{ m/s}^2$

Homework:
p.144 # 5-7